gas supply rate to the chamber, wherein the chamber comprises a releasable coupling member for releasably attaching to a load.

The device according to the present invention can be used for lowering to the seabed of heavy loads (500 tons or more) in relative deep water (for example 1000m). The lifting unit can be connected to and disconnected from the load and includes a large, "soft volume" structure which has an opening to the environment in the lower part and which can be filled with a gas above its opening to add buoyancy. Due to the fact that the chamber if the lifting unit is not a closed pressure module, the construction can be relative simple and can be constructed at low costs as there will be no pressure differences between the inside and the outside of the module. The gas (air) inside the open chamber will compensate the weight of the chamber and the weight of the load to be transported to or from the seabed, at any position during the lowering and raising. Adding gas will ensure a controlled lowering /deployment of the combination of the device and the connected package, for example creating an uplift of 490-500 tons at a load of 500 tons. During the way down, gas (such as for instance air or Nitrogen) needs to be added into the chamber as the gas trapped in it the will be reduced in volume due to the increase of the external water pressure. The combination of lifting device and load sinks due to the resultant small negative buoyancy of the combination, which can be controlled, from the floating barge by a vent system on the module. After depositing the load on the seabed, gas is removed from the chamber via a gas release mechanism to maintain neutral buoyancy on a small positive buoyancy after disconnecting of the load such that the lifting unit can be retrieved at the water surface.

The control means connected to the gas supply means can comprise for instance an electrically or mechanically controlled valve in a gas supply duct to the chamber, or a remote control valve on the chamber which is actuated by means of a sonar system or radio transmitter or any equivalent means such as fibre optics or any other signal carriers.

During operation, the gas inlet opening is during use situated higher along a longitudinal height of the lifting unit than the equalisation opening. Gas introduced into the chamber will accumulate at the top whereas pressure equalisation with the surroundings takes place through the lower equalisation opening.

The gas supply means may, according to one embodiment, be placed on the floating structure, a fluid supply duct connecting the gas supply means to the chamber.

will not be accelerated upwards by its reduced mass, but can be raised to the surface in a controlled manner.

Some embodiments of a floating lowering and lifting device according to the present invention, will, by way of example, be explained in detail with reference to the accompanying drawings. In the drawings:

Fig. 1 shows a schematic view of the first embodiment which the chamber of the lifting device is supplied with gas from floating structure;

Fig. 2 is an embodiment in which the chamber of the lifting device is provided with a compressed gas source connected to the chamber;

Fig. 3 is an embodiment which a closed volume filled with foam or gas is comprised in the device; and

Fig. 4 is an embodiment comprising a heave and roll compensating mechanism.

Fig 1 shows a floating lowering and lifting device 1 comprising a vessel or barge 2 and a lifting unit 3. Lifting unit 3 comprises a chamber 5 provided with a releasable coupling member 7 carrying a load 8 that is to be raised from or lowered to the seabed. The chamber 5 comprises gas inlet opening 9 which is connected to a gas supply hose 11. The air hose 11 may be wound on an air hose reel 12 and may be attached to gas supply means 13 which may formed of a compressor or which may be a storage tanker comprising gas or compressed gas. A control valve 15 may be included in the air hose 11 for increasing or decreasing the gas supply rate from the tank of compressed air 13. The chamber 5 comprises furthermore a thruster 17 for positioning of the chamber and a controllable gas release valve 21, which may comprise a sonar detector 22 for communicating with sonar transmitter 23 for opening or closing of the valve 21. Sonar transmitter 23 may be operated from the vessel 2. Furthermore, the chamber 5 comprises equalisation openings 23, 25 in the lower wall 27 of the chamber 5 for equalising the pressure inside the chamber 5 with the ambient pressure. By controlling the valve 15, the gas supply rate to the chamber 5 is adjusted such as to lower the load 8 in a controlled manner at the same time the air hose is wound from the reel 12 for positional purposes and for retrieval of the chamber 5 onto the vessel, the chamber 5 is connected to a guide cable 29 that is connected to a crane 30 on the vessel.

Fig. 2 shows an embodiment in which tank 32 comprising compressed nitrogen is attached to the chamber 5. Compressed nitrogen can be entered into chamber 5 via a controllable valve 31 which is connected to electric signal control cable 32, operated

Claims

1. Floating lowering and lifting device comprising a floating structure and a lifting unit lowerable from the floating structure towards the sea bed, the lifting unit having a chamber with a least one gas-inlet opening in its wall and an equalisation opening in its wall, a gas supply means being connected to the gas inlet opening, the device comprising a control means connected to the gas supply means for controlling a gas supply rate to the chamber, wherein the chamber comprises a releasable coupling member for releasably attaching to a load.

2. Floating lowering and lifting device according to cliam 1, the gas inlet opening during use being situated higher up along a longitudinal height of the lifting unit than the equalisation opening.

3. Floating lowering and lifting device according to claim 1 or 2, wherein the gas supply means are placed on the floating structure, a fluid supply duct connecting the gas supply means to the chamber.

4. Floating lowering and lifting device according to claim 3, wherein the gas supply means comprises a container with a compressed gas, the control means comprising a valve connected to the fluid supply duct, or a compressor, the control means comprising a power control operatively associated with the compressor.

5. Floating lifting device according to claim 1 or 2, wherein the gas supply means comprise a container connected to the chamber via a controllable valve, the container comprising a compressed gas and being lowerable with the chamber, the control means being connected to the valve for controlling the gas supply to the chamber.

6. Floating lifting device according to any of the preceding claims, wherein the chamber is suspended from the floating structure via a guide cable.

7. Floating lifting device according to any of the preceding claims, the chamber comprising at least one thruster powered via the control line.

8. Floating lifting device according to any of the preceding claims, wherein the chamber comprises a closed compartment.

9. Floating lifting device according to any of the preceding claims, wherein the guide cable or control line is connected to an arm on the floating structure, the arm comprising a sheave, and a counterweight attached to the sheave via an arm, the sheave being suspended from the arm.

10. Floating lowering and lifting device according to any of the preceding claims, having a gas release mechanism connected to a control means which is adapted to open the gas release mechanism after placing the load on the sea bed, prior to detaching the releasable coupling member.

11. Method of raising and lowering an object from the seabed comprising the steps of:

- attaching a load to the lifting unit according to any of the preceding claims;
- adding or releasing a gas into or from the chamber in dependence of the water depth while maintaining an open connection of the chamber with the sea via the equalisation opening.

12. Method according to claim 11, wherein upon depositing the load onto the seabed gas is released from the chamber to maintain a substantially predetermined buoyancy when the weight of the load is transferred from the lifting unit to the seabed.

Fig 1